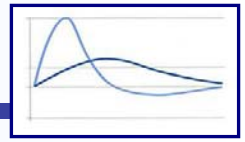
Practical Use of the Glycemic Index

Introduction

Let's discuss:

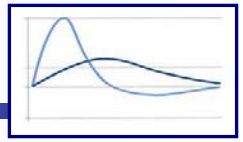
- Glycemic Index
- Glycemic Load
- Health Benefits
- What to Eat
- Case Study
- Hands-on Activities



Glycemic Index (GI)

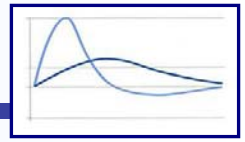
What is the glycemic index?

A scale that ranks carbohydrates by how much they raise blood glucose levels compared to a reference food.



Glycemic Index (GI): Ranking

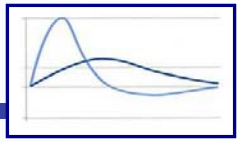
Low	0 – 55
Moderate	56 – 69
High	70 or more



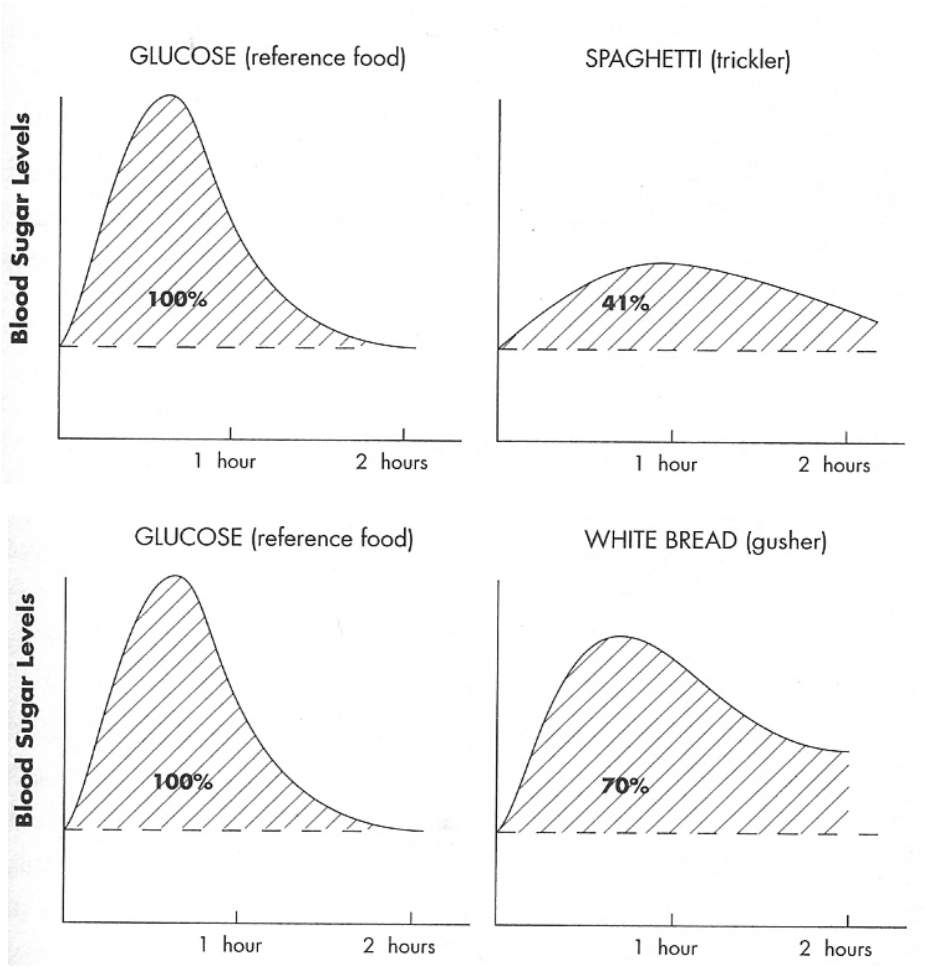
Glycemic Index (GI): Protocol

1. 25 or 50 grams carbohydrate of test food.
2. Blood samples taken:
   - 1st hour: every 15 minutes
   - 2nd hour: every 30 minutes
   - 3rd hour: every 30 minutes*
3. Values plotted; AUC calculated.
4. Test food response compared to reference food response.
5. Average GI of 8-10 volunteers = GI of test food.

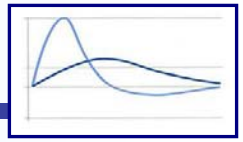
** DM volunteers only.*



Glycemic Index (GI): Sample Graphs

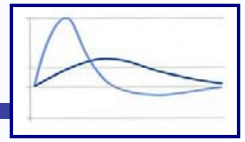


Adapted from *Good Carbs Bad Carbs* Reprinted courtesy of Marlowe & Company.



Factors Influencing GI Ranking

- Type of starch



Factors Influencing GI Ranking

Type of Starch

Amylose

- Absorbs *less* water
- Molecules form *tight clumps*
- *Slower* rate of digestion

Amylopectin

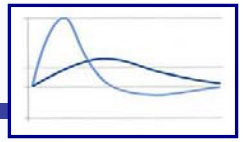
- Absorbs *more* water
- Molecules are *more open*
- *Faster* rate of digestion

Lower GI

Kidney beans (28)
Uncle Ben's converted LG rice (50)

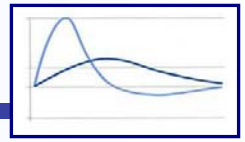
Higher GI

Russet potato (85)
Glutinous rice (98)



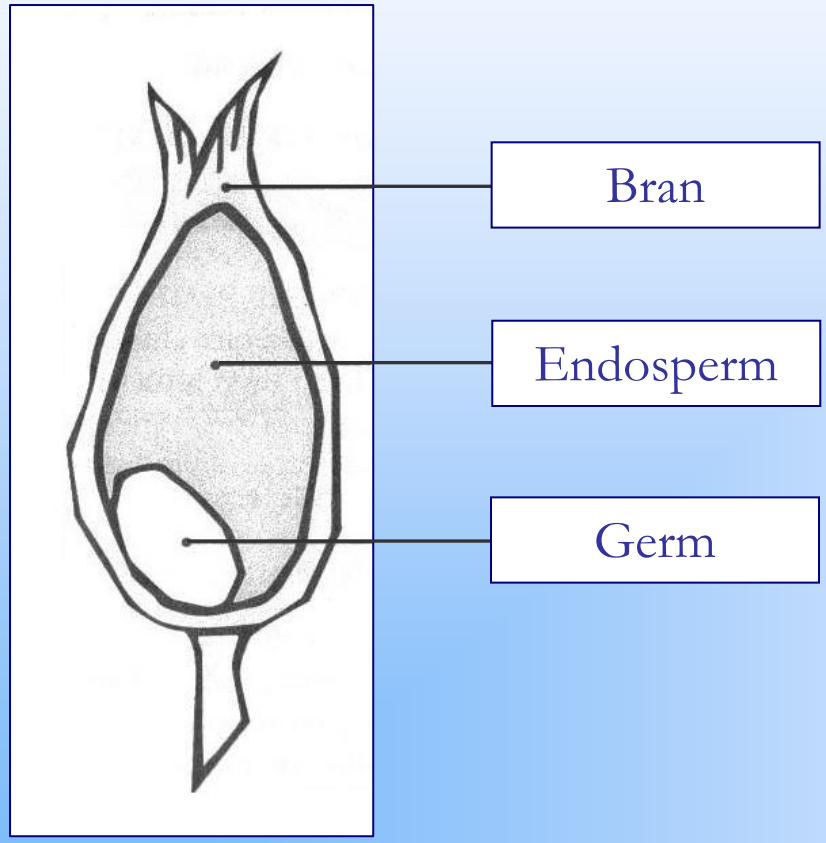
Factors Influencing GI Ranking

- Type of starch
- Physical entrapment



Factors Influencing GI Ranking

Physical Entrapment



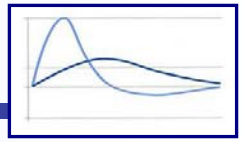
Bran acts as a physical barrier that slows down enzymatic activity on the internal starch layer.

Lower GI — All Bran (38), Pumpernickel bread (50)

Higher GI — Bagel (72), Corn Flakes (92)

Factors Influencing GI Ranking

- Type of starch
- Physical entrapment
- Viscosity of fiber

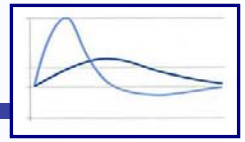


Factors Influencing GI Ranking

Viscosity of Fiber

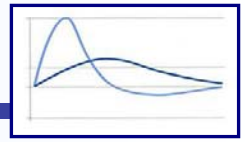
Viscous, soluble fibers transform intestinal contents into gel-like matter that slows down enzymatic activity on starch.

Lower GI	Higher GI
Apple (40)	Whole wheat bread (73)
Rolled oats (51)	Cheerios (74)



Factors Influencing GI Ranking

- Type of starch
- Physical entrapment
- Viscosity of fiber
- Sugar content



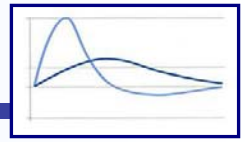
Factors Influencing GI Ranking

Sugar Content

sugar ⇨ sucrose ⇨ glucose + fructose
(GI 60) (GI 100) (GI 19)

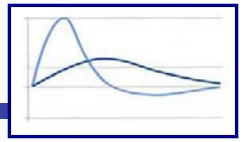
starch ⇨ maltose ⇨ glucose + glucose
(GI 105) (GI 100) (GI 100)

Lower GI	Higher GI
Frosted Flakes (55)	Golden Grahams (71)
Raisin Bran (61)	Rice Krispies (82)



Factors Influencing GI Ranking

- Type of starch
- Physical entrapment
- Viscosity of fiber
- Sugar content
- Fat and protein content

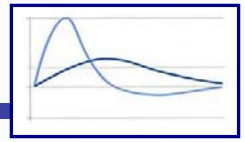


Factors Influencing GI Ranking

Fat & Protein Content

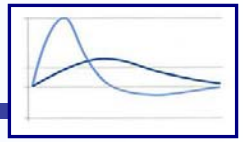
Fat and protein slow down gastric emptying, and thus, slows down digestion of starch.

Lower GI	Higher GI
Peanut M&M's (33)	Jelly beans (78)
Potato chips (54)	Baked potato (85)
Special K (69)	Corn Flakes (92)



Factors Influencing GI Ranking

- Type of starch
- Physical entrapment
- Viscosity of fiber
- Sugar content
- Fat and protein content
- Acid content

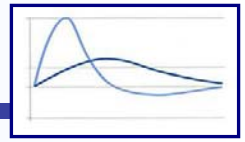


Factors Influencing GI Ranking

Acid Content

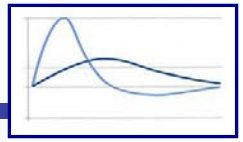
Acid slows down gastric emptying, and thus, slows down the digestion of starch.

Lower GI	Higher GI
Sourdough wheat bread (54)	Wonder white bread (73)



Factors Influencing GI Ranking

- Type of starch
- Physical entrapment
- Viscosity of fiber
- Sugar content
- Fat and protein content
- Acid content
- Food processing

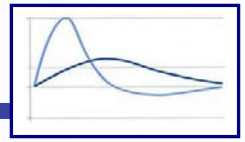


Factors Influencing GI Ranking

Food Processing

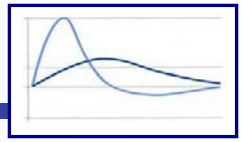
Highly processed foods require less digestive processing.

Lower GI	Higher GI
Old fashioned, rolled oats (51)	Quick, 1-minute oats (66)



Factors Influencing GI Ranking

- Type of starch
- Physical entrapment
- Viscosity of fiber
- Sugar content
- Fat and protein content
- Acid content
- Food processing
- Cooking

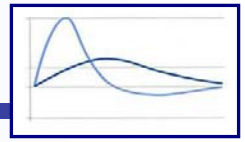


Factors Influencing GI Ranking

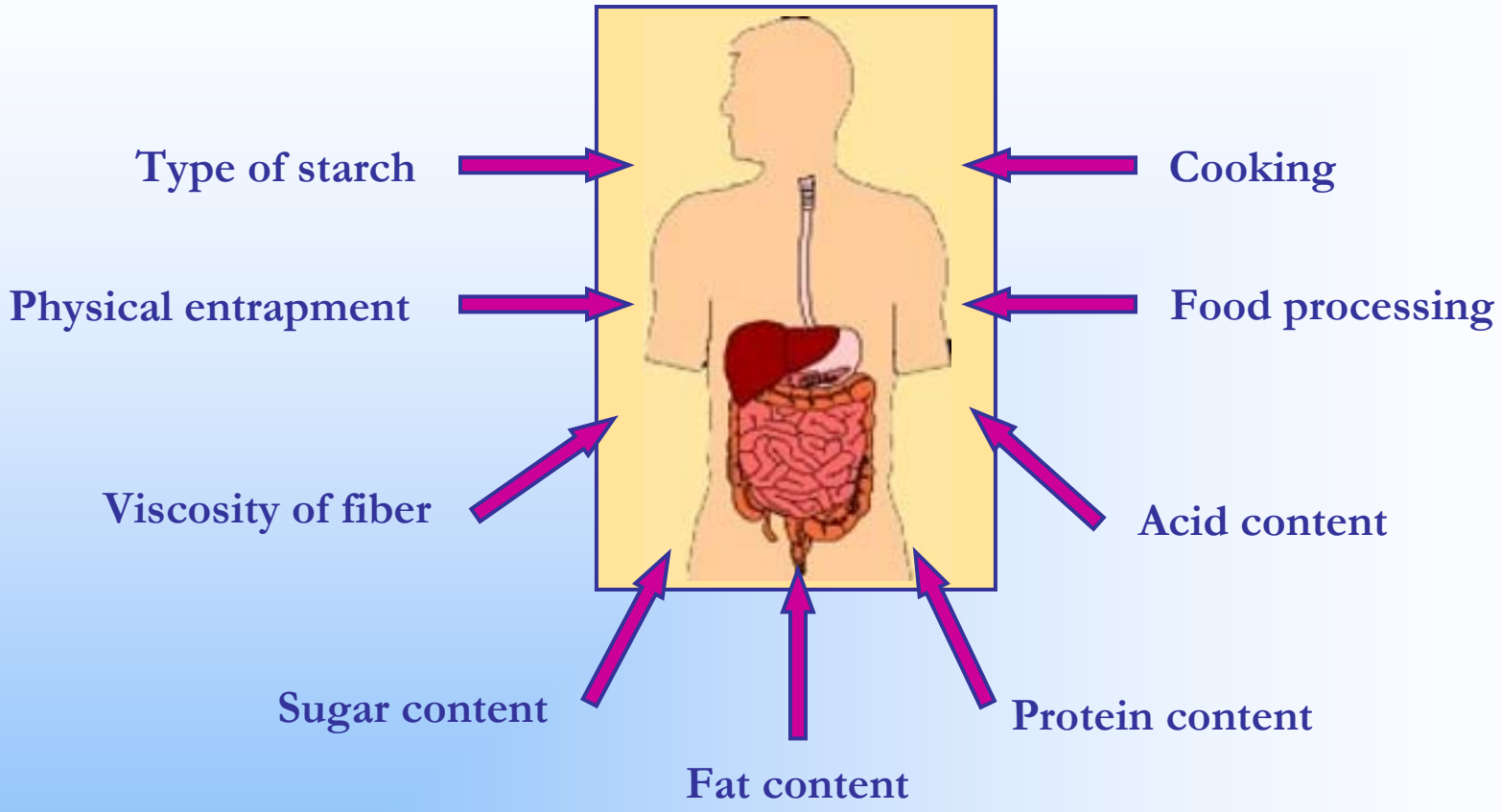
Cooking

Cooking swells starch molecules and softens foods, which speeds up the rate of digestion.

Lower GI	Higher GI
Al dente spaghetti – boiled 10 to 15 minutes (44)	Over-cooked spaghetti – boiled 20 minutes (64)

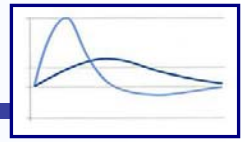


Factors Influencing GI Ranking



How does all this affect our glycemic levels?

How does all this make us feel after eating carbohydrate-containing foods?



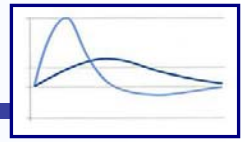
Glycemic Load (GL): What does it mean?

Glycemic load measures the degree of glycemic response and insulin demand produced by a specific amount of a specific food.

Glycemic load reflects both the quality and the quantity of dietary carbohydrates.

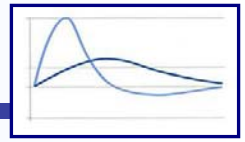
GL = GI/100 x CHO (grams) per serving

Example: GL of an apple = 40/100 x 15g = 6g



Glycemic Load (GL): Calculation

1/2 cup converted, LG rice	38/100 x 22g	=	8 g
1/2 cup glutinous rice	98/100 x 29g	=	28 g
2 1/4 Tbsp glutinous rice	98/100 x 8g	=	8 g
1 2/3 cups converted, LG rice	38/100 x 73g	=	28 g



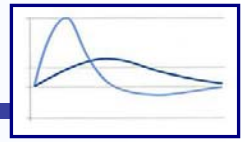
Glycemic Load (GL): Ranking

Individual food portion:

Low	0-10
Moderate	11-19
High	20+

Whole day:

Low	< 80
Moderate	100
High	> 120



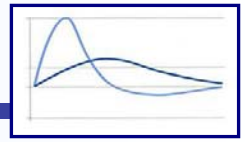
GI vs. GL

Glycemic Index: ranks carbohydrates based on their immediate blood glucose response.

GI = glycemic quality

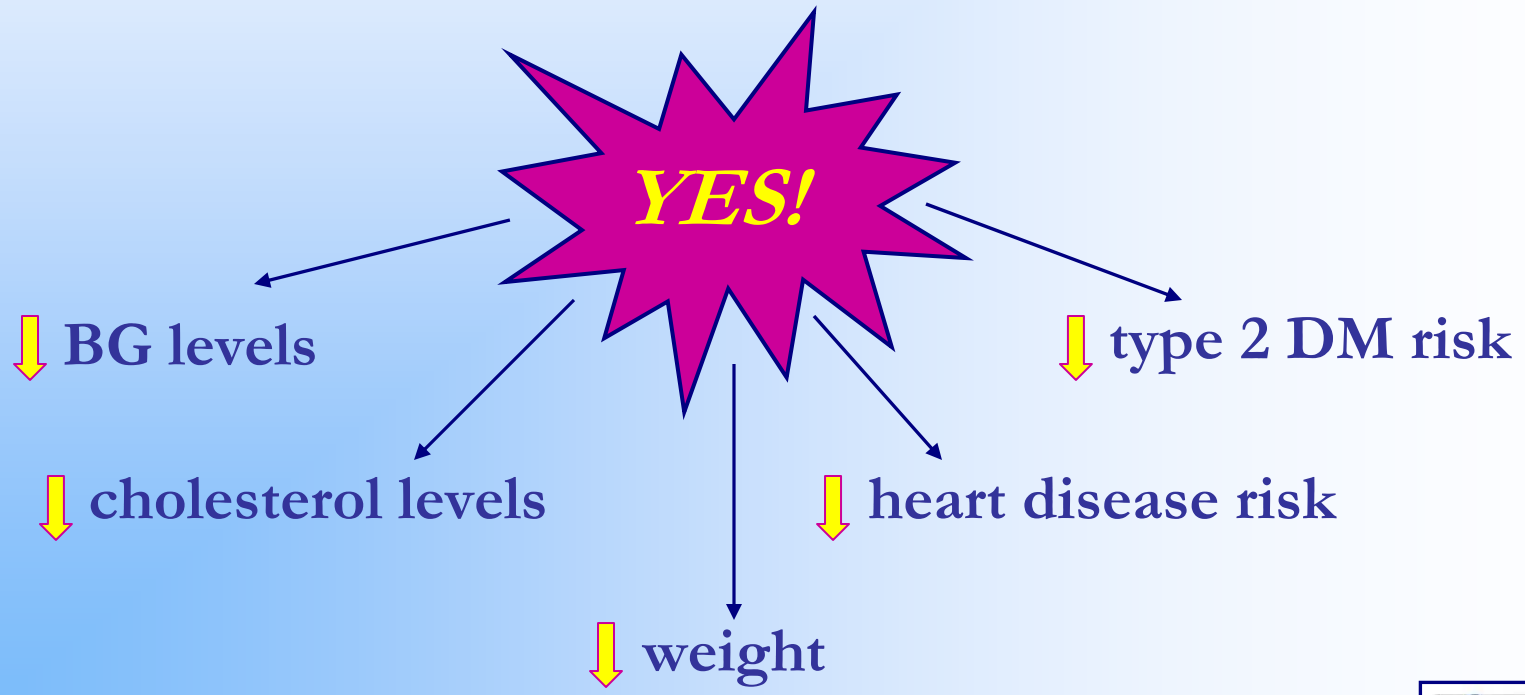
Glycemic Load: helps predict blood glucose response to specific amount of specific carbohydrate food.

GL = glycemic → *quality*, *quantity*



Benefits of Low GI Diet

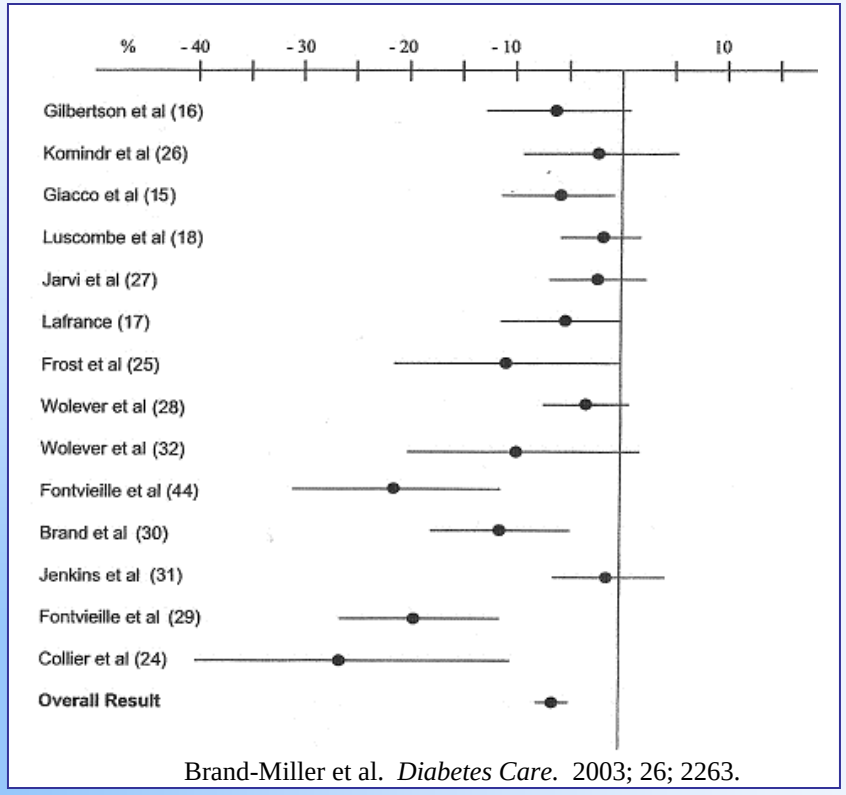
Are there any documented benefits to lowering the GI of one's diet?



Benefits of Low GI Diet

Low GI diet helps lower blood glucose levels.

Meta-analysis of 14 studies, 356 subjects (types 1 & 2 DM), 2-52 weeks duration



Brand-Miller et al. *Diabetes Care*. 2003; 26; 2263.

Mean difference

- 7.4% in glycated proteins ***over & above*** reduction from high GI diet.
- 0.43% points in HbA1c ***over & above*** reduction from high GI diet

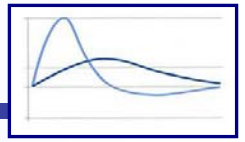
Benefits of Low GI Diet

Low GI diet helps lower blood glucose levels.

EURODIAB IDDM Complications Study, 1996
2,054 people, 15-60 y, with type 1 DM

	GI	HbA1c
Lowest quartile	**58-78**	**6.04**
Highest quartile	**86-112**	**6.60**

Buyken et al. *Am J Clin Nutr*. 2001; 73; 578.



Benefits of Low GI Diet

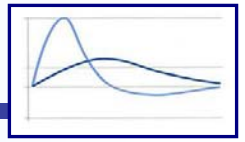
Low GI diet aids in weight control.

Nurses' Health Study, 1984-1996
74,091 women, 38-63 y

Calculated odds ratios (lowest > highest quintiles)

	BMI (≥30) n = 6,400	Major weight gain (≥25kg) n = 657
Whole grains	**-19%**	**-23%**
Refined grains	**+18%**	**+26%**
Dietary fiber	**-34%**	**-49%**

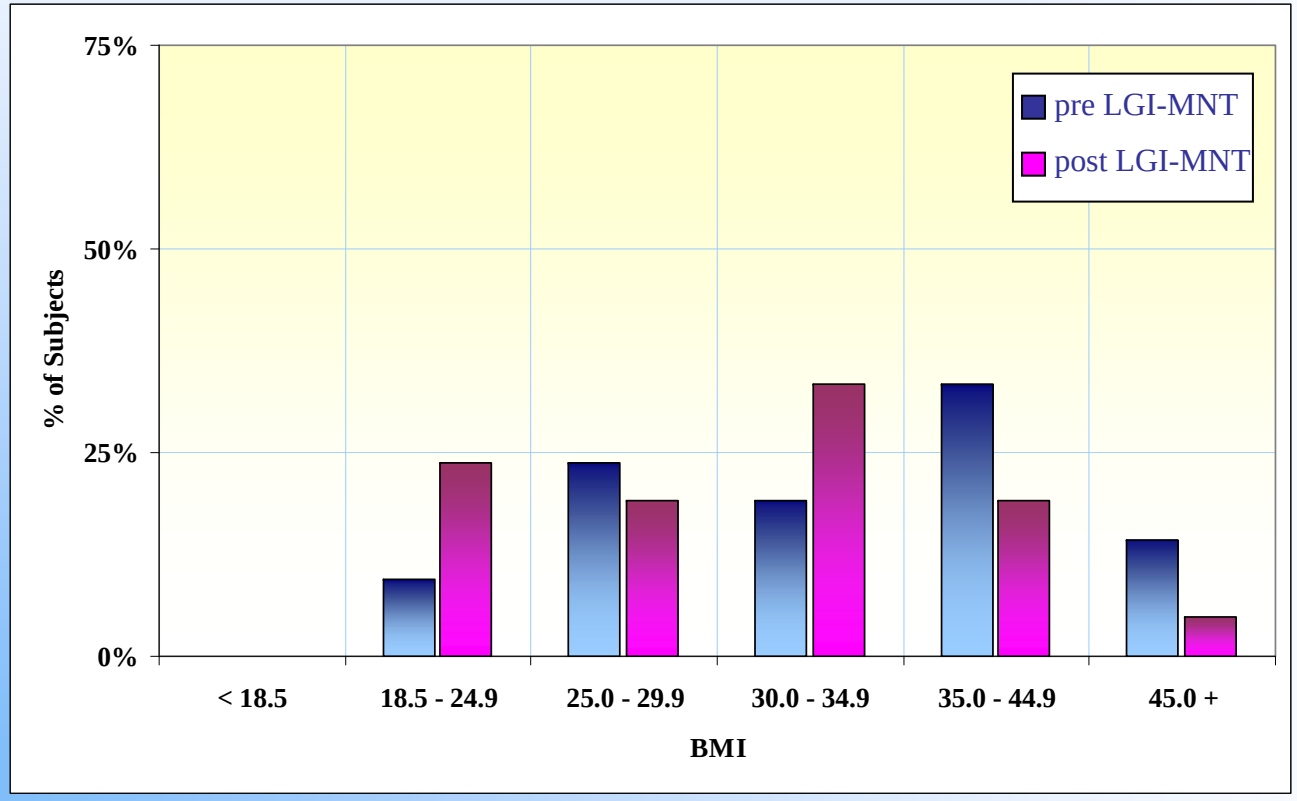
Lin et al. *Am J Clin Nutr*. 2003; 78; 923.



Benefits of Low GI Diet

Low GI diet aids in weight control.

Post low GI MNT counseling, 21 subjects, 21-89 y, 3-36 mos.



Burani & Longo. *Diabetes Educ.* 2006; 32; 83.

Benefits of Low GI Diet

Low GI diet decreases risk of diabetes.

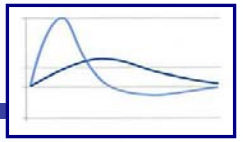
Nurses' Health Study, 1986-1992

65,173 US women 40-65 y, free of DM

6 year follow-up: 915 cases of type 2 DM

	Relative risk
⇧ GI	1.37
⇧ GL	1.47
⇧ cereal fiber	0.72
⇧ GL ⇩ cereal fiber	2.50

Salmeron et al. *JAMA*. 1997; 277; 472.



Benefits of Low GI Diet

Low GI diet decreases risk of diabetes.

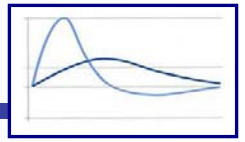
Health Professionals' Follow-up Study, 1986-1992

42,759 US men 40-75 y, free of DM

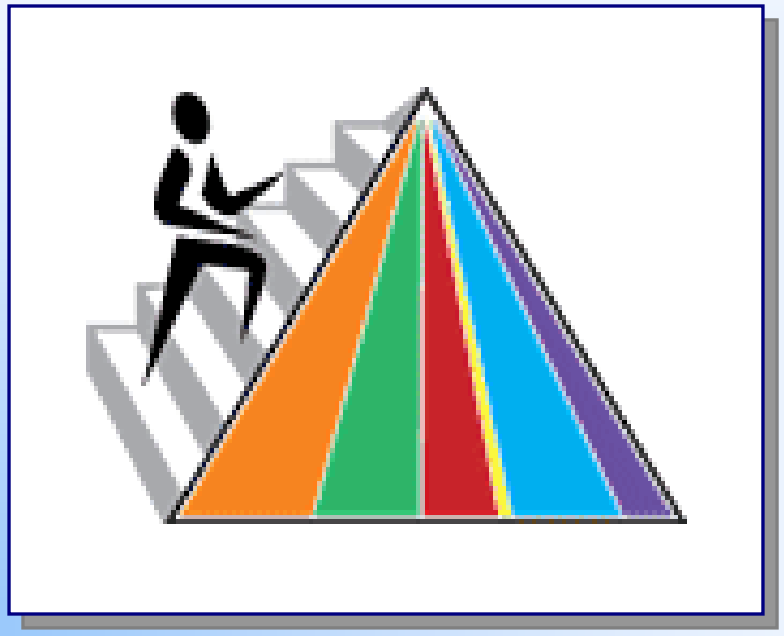
6 year follow-up: 523 cases of type 2 DM

	Relative risk
⇧ GI	1.37
⇧ cereal fiber	0.70
⇧ GL ⇩ cereal fiber	2.17

Salmeron et al. *Diabetes Care*. 1997; 20; 245.



What Should I Eat?

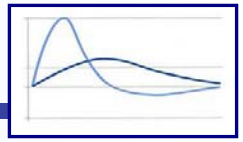


http://www.mypyramid.gov

What Should I Eat?

2005 Dietary Guidelines

- Balance calories in with calories out.
- Eat balanced diet with variety of nutrient-dense foods and beverages.
- Consume 2 cups fruit, 2½ cups vegetables per day. (2,000 calories intake)
- Choose whole grains for at least half of daily grain consumption.
- Consume 3 cups FF/LF milk or equivalent.
- Keep fat consumption 20-35% of daily calories. (mono & polyunsaturated)
- Consume less than 2300 mg sodium/day.
- Choose foods with little added sugar or caloric sweeteners.
- Drink alcohol in moderation.
- Practice food safety handling and preparing rules.



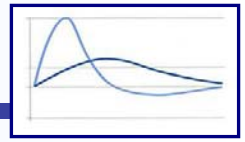
Caution!

Do not focus exclusively on achieving a low glycemic load diet with all low glycemic index food choices.

Result could be:

high fat
low carbohydrate
low fiber
calorically dense

Instead…



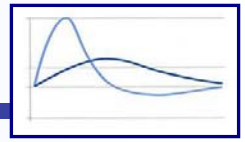
A Better Idea

Aim for a well-balanced diet that includes low glycemic index carbohydrates. Use glycemic load as a guide for controlling portions.

Hint:

*Low GI CHOs **allow for larger portions**, while regulating the GL.*

*High GI CHOs **require smaller portions** to regulate the GL.*



Pictures of Low/High GI Meals & Snacks

GI = 60 GL = 48

GI = 42 GL = 31

Pictures of Low/High GI Meals & Snacks

GI = 85 GL = 48

GI = 39 GL = 22

Pictures of Low/High GI Meals & Snacks

GI = 83 GL = 19

GI = 14 GL = 1

Pictures of Low/High GI Meals & Snacks

GI = 80 GL = 32

GI = 61 GL = 12

Pictures of Low/High GI Meals & Snacks

GI = 57 GL = 31

GI = 32 GL = 16

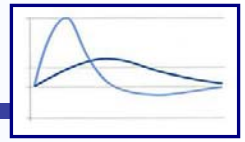
What Should I Eat?

How to increase consumption of low GI foods

Eat high-fiber breakfast cereals
(oats, bran, barley)

OR

Add berries, nuts, flaxseed and cinnamon
to high GI cereals.



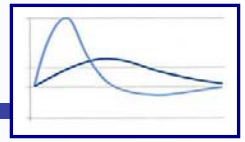
What Should I Eat?

How to increase consumption of low GI foods

Choose dense, *whole* grain and sourdough breads and crackers.

OR

Add a heart-healthy protein and/or condiment to high GI breads and crackers.



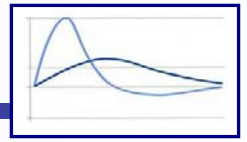
What Should I Eat?

How to increase consumption of low GI foods

Include 5-9 servings of
fruits and vegetables every day.

OR

No ifs, ands or buts – just do it!
(Mom was right.)



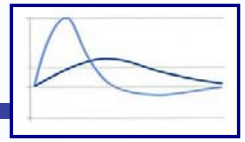
What Should I Eat?

How to increase consumption of low GI foods

Replace white potatoes with
yams or sweet potatoes.

OR

Try canned new potatoes, or just eat
smaller portion of high GI potatoes.



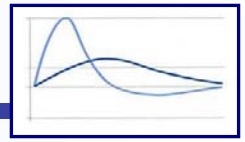
What Should I Eat?

How to increase consumption of low GI foods

Eat less refined sugars and convenience foods (soda, sweets, desserts, etc.)

OR

Combine nuts, fruit, yogurt, ice cream with commercial sweets – just watch portion sizes.



Case Study – “Amy”

38 YO administrative assistant

Married, no children

Height: 5’7”

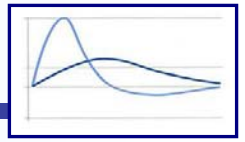
Weight: 320 lbs.

BMI: 50 (severe obesity)

Type 2 DM since age 35

A1c: 6.3 (Glucophage 500 mg)

BP: 148/90 (Altace 10 mg)



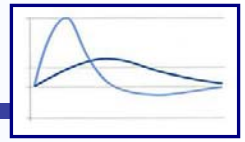
Case Study – Amy's *Before* Diet

Breakfast:	toasted bagel with cream cheese, 16 oz. orange juice, large coffee with whole milk
Lunch:	6" roast beef & cheese sub sandwich w/ mayo, 20 oz. diet Pepsi
Snack:	("all afternoon long") 13 oz. bag Hershey miniature chocolate bars
Dinner:	½ box macaroni & cheese (made w/ 2% milk), 3 beef hot dogs on buns, water
Snack:	1 ½ cups ice cream

6250 Kcal: 43% CHO (666g), 11% PRO (173g), 46% fat (321g)

GI = 57 (moderate)

GL = 352 (*very* high)



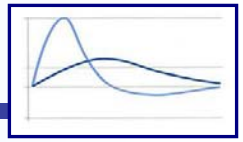
Case Study – Amy's *After* Diet

Breakfast:	2 slices 100% WW toast, 1 Tbsp natural, NSA peanut butter, 1 Tbsp all-fruit jelly, 1 cup fresh strawberries, large coffee w/ skim milk
Lunch:	4 oz. grilled chicken breast, large green salad with varied fresh vegetables & 2 Tbsp vinaigrette dressing, small boiled sweet potato, orange, diet iced tea
Snack:	6 oz. light yogurt, ½ cup cherries (frozen)
Dinner:	4 oz. grilled salmon w/ lemon juice, 1 cup pasta w/ 1 cup broccoli rabe, 1 Tbsp olive oil, water
Snack:	apple

2150 Kcal: 47% CHO (251g), 19% PRO (104g), 34% fat (82g)

GI = 39 (low)

GL = 61 (low)



Case Study – “Amy”

3 years later

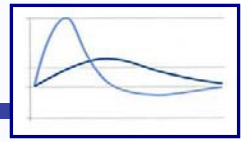
Weight: 205 lbs

BMI: 32 (mild obesity)

A1c: 5.2

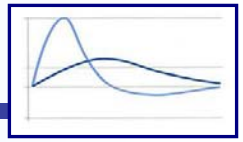
BP: 120/60, RHR 47

Medications: none.



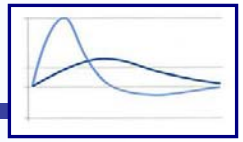
Patient Empowerment Model

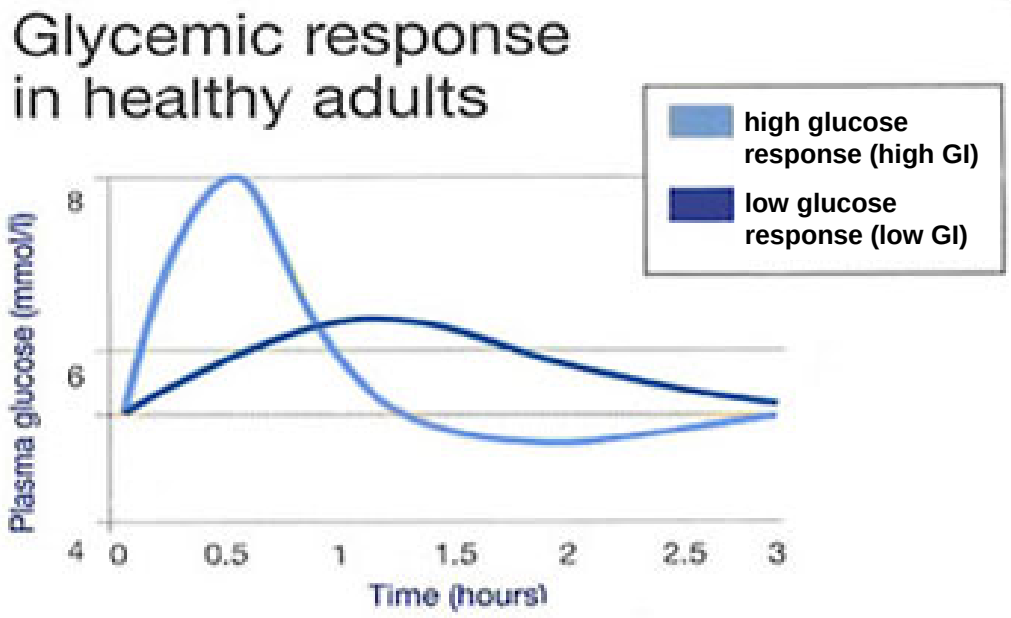
The patient makes self-directed, informed decisions about personal behavioral changes.



Practitioner's Empowerment Model

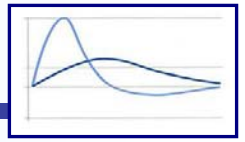
The practitioner makes self-directed, informed decisions about professional educational changes.





Plasma glucose response (mmol/L) from a high vs. low GI food. The change in blood glucose concentration over time is expressed and calculated as the area under the curve (AUC) (Wolever et al, 1991).

www.glycemicindex.com



Thank You!